

REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended in light of the following discussion is respectfully requested.

Claims 1, 6-18, 20, 24, and 25 are now pending in this application. Claim 5 is herein canceled. Claims 19 and 21-23 were previously canceled. Claims 1 is herein amended. Claim 25 is added. Support for the amendment and new claim is found at least in the original claims and in the specification at page 5, lines 12-13. No new matter is added.

In the outstanding Office Action, claims 1, 5-18, 20, and 24 were rejected under 35 U.S.C. § 103(a) as obvious over Kondo, U.S. Patent No. 4,244,934, in view of EP 1211221A1, and further in view of McAllister, U.S. Patent No. 4,837,073.

Claim 1, from which claims 6-9, 20, and 24 depend directly or indirectly, is herein amended. As presently amended, claim 1 is directed to a shaped expanded graphite article having an oxidation-resistant coating layer, at least in its outer layer portion. The oxidation-resistant coating layer has a thickness of 0.5  $\mu\text{m}$  or more, and comprises a boron element and a phosphorus element. The oxidation-resistant coating layer is 15 mass % or more boron element, and 2 mass % or more phosphorus element. Moreover, the content of the boron element in the oxidation-resistant coating layer is greater than the content of the phosphorous element in the oxidation-resistant coating layer.

None of the cited references disclose or suggest a graphite article having an oxidation-resistant coating layer which is greater than 0.5  $\mu\text{m}$  thick, and which has a higher content of boron than phosphorus. As noted in the Specification at page 6, having a thickness of 0.5  $\mu\text{m}$  or more for the oxidation-resistant coating layer serves an important function in the present invention, in that thicknesses less than 0.5  $\mu\text{m}$  do not allow maintaining the rate of oxidation loss at 800°C to 30 mass% or less. This is further exemplified in Table 1, which shows the much higher rate of oxidation loss for examples having coating layer thickness less than 0.5

$\mu\text{m}$ . Further, the thickness takes account of the components (boron element and phosphorus element) of the oxidation-resistant coating layer. It is particularly noted that the content of the boron element in the oxidation-resistant coating layer is greater than the content of the phosphorous element in the oxidation-resistant coating layer.

The cited references do not suggest the problem to be solved by the present invention, and thus cannot motivate one skilled in the art to modify the disclosure to make the claimed invention. They do not discuss preventing oxidation at  $800^{\circ}\text{C}$ . Instead, Kondo only discusses oxidation resistance at temperatures of  $500^{\circ}\text{C}$  or higher. EP1211221 only mentions oxidation resistance at temperatures of  $700^{\circ}\text{C}$  or higher. McAllister only mentions oxidation resistance at temperatures within a range of 500 to  $750^{\circ}\text{C}$ . Lacking any discussion of the problem addressed by the present invention, one skilled in the art would not be led to vary the components of the cited references to result in the claimed invention.

Further, none of the references disclose or suggest a coating layer containing more boron element than the phosphorus element. In particular, McAllister contains no indication that the content of boron element is more than that of phosphorus element. McAllister discloses, in Table II, five aqueous penetrant solutions. See col. 3-4. Applicants have calculated the content of boron and phosphorus in the listed solutions.<sup>1</sup> As shown in the

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<sup>1</sup> The calculations were all completed in the same manner, and are described herewith for solution D:  $\text{H}_3\text{PO}_4$  has a molecular mass of 98.  $\text{MnHPO}_4 \cdot 1.6\text{H}_2\text{O}$  has a molecular mass of 179.8.  $\text{AlH}_2\text{PO}_4$  has a molecular mass of 124.  $\text{B}_2\text{O}_3$  has a molecular mass of 70.  $\text{Zn}_3\text{PO}_4$  has a molecular mass of 291.2. The content of P in  $\text{H}_3\text{PO}_4$  is calculated as 14.3 ( $53.2\text{wt}\% \times 0.85 \times 31/98$ ). The content of P in  $\text{MnHPO}_4 \cdot 1.6\text{H}_2\text{O}$  is calculated as 0.36 ( $2.1\text{wt}\% \times (31/179.8)$ ). The content of P in  $\text{AlH}_2\text{PO}_4$  is calculated as 1.21 ( $9.7\text{wt}\% \times 0.5 \times 31/124$ ). The content of P

following table, the disclosed solutions in McAllister all have significantly higher contents of phosphorus than boron:

	Quantity of Phosphorus	Quantity of Boron
Penetrant A	15.0	0.56
Penetrant B	15.6	0.34
Penetrant C	15.9	0.28
Penetrant D	16.1	0.19
Penetrant E	15.8	0.62

McAllister fails to teach anything about the thickness of the oxidation-resistant coating layer, instead only mentioning the thickness of the barrier layer. And McAllister fails to teach that the content of boron is higher than the amount of phosphorus.

Kondo likewise fails to teach anything about the boron element quantity being greater than the content of phosphorus. The graphite in Kondo contains 30 to 50 wt% of a boric acid aqueous solution whose content of a boric acid compound is 2 to 30%. See col. 7, line 65, through col. 8, line 9. Thus, the content of boron is at its maximum when the graphite contains 50 wt% of a boric acid aqueous solution which contains 30% of boric acid compound. After dehydration, the content of boric acid compound is approximately 23.1 wt%. The content of boron in the boric acid compound is estimated to be approximately 10% because the boric acid compound of Kondo is a boric acid salt with esterified saccharide. Using sucrose (molecular mass: 342) as a specific example of saccharide, Kondo describes that an ester bond is formed between a -CH<sub>2</sub>OH group of the sucrose and boric acid. This

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in Zn<sub>3</sub>PO<sub>4</sub> is calculated as 0.27 (2.5wt% x 31/291.2). The content of boron in B<sub>2</sub>O<sub>3</sub> is calculated as 0.19 (0.6wt% x 22/70).

means that each molecule of the sucrose has as many as three ester bonds. The molecular mass of the sucrose is 342 and that of boron is 10.8. Thus, the ratio of molecular masses of sucrose versus boron is 342: 32.4 ( $=10.8 \times 3$ ). Therefore, the content of boron in the boric acid compound (obtained by the ester bonding between sucrose and boric acid) is 10% at the most. As such, the content of boron in the Kondo 23.1 wt% of boric acid compound is 2.3 wt%. This is a significantly lower content of boron than the content of boron (15 wt%) described in the present invention.

Neither of the references teach anything about a graphite article having an oxidation-resistant coating layer which is greater than 0.5  $\mu\text{m}$  thick, and which has a higher content of boron than phosphorus, so that the rate of oxidation loss at 800°C is maintained at 30 mass% or less. Indeed, all of the references teach articles having phosphorus content greater than the boron content, effectively teaching away from the present invention. Failing to teach all of the elements, and failing to provide the teaching or motivation to modify the references to reach the claimed invention, the cited references do not render claim 1, or the claims depending therefrom, obvious. Applicants respectfully request allowance of these claims.

The Office has rejected claims 10-18 as obvious over Kondo, in view of EP 1211221A1, and further in view of McAllister. In the rejection, the Office asserts that these are product-by-process claims, and that they are obvious because the product claimed is the same or obvious over the product in Kondo, the EP reference, and McAllister. Applicants again note that claims 10-18 are not product-by-process claims. Claims 10-18 are pure process claims. The cited references do not teach or suggest the method of claims 10-18. Accordingly, Applicants respectfully request withdrawal of the present rejection of these claims.

In light of the above discussion, the present application is believed to be in condition for allowance. An early and favorable action to that effect is respectfully requested.

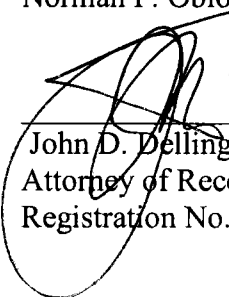
Respectfully submitted,

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